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Experiments for the Control of the White Pine Weevil in 1948

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Experiments for the Control of the White Pine Weevil in 1948.

J. V. Schaffner, Jr. and W. E. Smith
(N.Y. State Conservation Department)

Introduction

The cooperative project with the New York State Conservation Department in 1947 for the control of the white pine weevil (Pissodes strobi Peck), by aerial spraying with DDT produced some promising results. The dosages which offered the most promise, however, were relatively high and required two or three applications, so they may be too expensive for general practise. It was also learned that delaying the operations until the majority of the current year's brood of adults had emerged (about September 1st) permitted only a rather short period for aerial spraying before the approach of cold weather, when the beetles enter hibernation. Adverse weather conditions at this time of year caused serious delays in carrying out the aerial spraying program.

Inasmuch as the white pine weevil is the most serious insect pest of white pine and Norway spruce in forest plantations, and because of the many thousands of acres now heavily infested, it was deemed imperative that experiments be continued until satisfactory control measures are discovered.

Experimental Work in 1948

Additional laboratory tests were made in the spring of 1948, using DDT and some of the other recently developed insecticides to determine their effectiveness in killing the white pine weevil. A report on the results was submitted on June 15, 1948.

In these experiments some white pine trees, 5 to 8 feet in height, were sprayed by means of hand atomizers. Sample twigs were collected soon after the sprays had dried and at intervals thereafter. Each twig was placed in a utility jar in the laboratory with either 5 or 10 weevils, depending upon the supply of weevils on hand. Records were made and fresh twigs supplied at intervals of 2 or 3 days. The results of these tests indicated that Toxaphene and liquid benzene hexachloride, in addition to DDT, offered good possibilities for the control of the white pine weevil.

Following the completion of the 1948 laboratory tests a program was prepared for large scale tests in heavily infested plantations in New York, which included hand applications in addition to the aerial spraying.

Selection of Area for Treatment

Some excellent 8 to 10 year old stands of white pine, a few mixed with Norway spruce were examined in 1945 and found to have suffered only minor damage by the weevil. These are located on a N. Y. State reforestation area in the northern part of Chenango County in the Townships of Georgetown and Otselic at an elevation of about 1800 feet. By the summer of 1947, however, the infestation had increased so that 25 to 30 percent of the white pines were infested. A further increase in infestation was observed on this area in the summer of 1948, so it was decided that the insecticidal treatments be made on this and nearby plantations. These plantations are within 15 or 20 airline miles from the airport in Norwich.

Hand Applications

In the sampling made in September 1947 to obtain data on the population of weevils in the plots, it was found that 95 percent of the adults were feeding on weeviled trees, very probably the trees from which they had emerged. This prompted experiments by spraying only the upper whorl of green foliage on all trees showing a 1948 weeviled leader. Two twenty-acre plots were established in a rectangular block of 40 acres on Chenango County reforestation area #2, in the Township of Otselic, N. Y., and they were sprayed by means of knapsack sprayers. This area of grassland on clay soil had been planted with white pine in the spring of 1942, and the survival has been poor. The white pines on a sample acre in each plot were counted and it was found that -

Plot A acre had a total of 224 trees, of which 92 were weeviled in 1948

Plot B acre had a total of 201 trees, of which 49 were weeviled in 1948

The height of the trees ranged from 2 to 7 feet, with the majority between 3 and 5 feet.

Concentrated emulsions were used on each plot. The insecticides used and the formulas were as follows:

Plot A - 8 lbs. DDT, 8 oz. Triton X 100, 8 qts. PD 544B, q.s. water to make 24 gallons.

Plot B - 4 lbs. DDT, 1 pint deodorized benzene hexchloride,("Isotex" containing 20 percent gamma isomer), q.s. water to make 12 gallons.

The spraying was done by efficient per diem employees assigned to the project by District Forester Baker. Some difficulties were experienced with the knapsack sprayers and the nozzles when treating the trees on plot A, so that the amount of spray used on this plot was far greater than normally would have been used. Data on the quantity of spray used, number of weeviled trees treated, and the man hours for making the applications are summarized as follows:

Plot	Date of Application	No. Weeviled Trees Sprayed	Man Hours	Average No. Trees per Hr.	Quantity of Spray Used	Average Quantity Per Tree
A	Aug. 11&13*	1352	13 2/3	101	22 gal.	†16.65 fl.oz.
B	Aug. 13	632	7 3/4	74	6.5 "	10.53 " "

On September 8 and 15, some four weeks after the treatment, the upper whorls on a number of trees in each plot were examined to obtain data on the effectiveness of the sprays. The results are as follows:

Date	Plot A		Plot B	
	No. Trees Sampled	No. of Weevils	No. Trees Sampled	No. of Weevils
Sept. 8	15	29	15	57
" 13	50	18	50	34

It is apparent from these samples that the applications were made too early, (the maximum emergence had not occurred at the time of treatment), and that the residual toxicity was not sufficient to kill all the adults during the entire period of emergence. Definite conclusions on the results of these treatments, however, cannot be made until the summer of 1949.

Airplane Applications

In order to avoid the inclement weather, which is so common in September, it was deemed advisable to make the 1948 experimental spray applications for the control of the white pine weevil during the latter half of August. It was hoped that the residual effect of the insecticides would be sufficient to kill all the adults, including those late in emerging from the terminals. Twelve plots, having a total of 680 acres were treated by airplane. Five formulations were used in replicates, totalling 10 plots. The formulations, gallonages per acre and dates of application are listed in the following table.

* Shower at 3.20 PM Aug. 11th, and showers Aug. 12 delayed operations.

† Mechanical difficulties caused a considerable loss of spray. See explanation above.

For solvents P.D.544B was used at the rate of one quart per pound of DDT, and kerosene at the rate of one pint per pound of Toxaphene. Triton X-100 was used as the emulsifying agent. In mixing the spray materials for each plot 1 1/6 quarts of the DDT concentrate were allowed for each pound of DDT required. However, an error was made with the Toxaphene solution as no allowance was made for increase in volume, and only one pint was used for each pound, whereas, about 1 1/3 pints should have been used.

Natural bounds such as roads, hedge rows, fields, and edges of hardwood stands, were used whenever possible in laying out the plots and the corners of each were marked with white cloth bags mounted on poles so they could be seen easily by the airplane pilot. The area in 10 of the 12 plots ranged from 26 to 62 acres, and these were paired up in a manner so as to obtain similar total acreages for each insecticide formulation. The acreages, formulations, and dates of applications for each plot were as follows:

Plot No.	Date Sprayed August	Acreage Each Plot	Acreage Treated with Each Formulation	Formulation and dosage per Acre
1	19	31)	88	2 lbs. DDT in 2 gal. emulsion
2	19 & 20	57)		
3	20	46)	91	1 lb.DDT,1 pt.BHC(E11) in 2 gal.emul.
7	20 & 23	45)		
4	23 & 24	40)	97	2lb.DDT,1 pt. BHC(E11)in 2 gal.emul.
8	25	57)		
5	25	29)	81	1 lb.DDT,1 pt.Toxaphene" 2 " "
9	25 & 26	52)		
6	26	62)	88	2 lb.DDT,1 pt.Toxaphene" 2 " "
10	27	26)		
11	Sept.2	65	65	2 lb.DDT,1.6" Toxaphene" 4 " "
12	1 &2	170	170	2 lb.DDT in 4 " "

Equipment and Materials

The Stearman biplane, used for making the spray applications, the trucks for hauling the materials, and the power mixer, equipped with a meter for measuring the insecticide emulsions when being pumped into the plane, were furnished by the N. Y. State Conservation Department. The spray materials were furnished jointly by the N. Y. State Conservation Department and the U. S. Bureau of Entomology and Plant Quarantine. The airplane was piloted by Robert Mason of the N. Y. State Conservation Department.

Application

The Norwich, N. Y. airport was used for the base of operations, and we wish to express our appreciation for the cooperation and assistance rendered by the Manager of the airport and his associates. This airport is situated in a valley at an altitude of approximately 1000 feet, and most of the plots were located on and close to Mullers Hill, Georgetown, at an elevation of about 1800 to 2000 feet. We were prepared to begin the spraying on the morning of August 18th, but soon found that fog in the valley and winds on the higher elevations were to cause serious delays in the operations. During the last half of August there was a dense fog over the airport nearly every morning and this usually did not lift until 8 or 9 o'clock, at which time winds and thermal air currents often were prevalent over the plots. Because of these conditions only 445 acres (10 plots) were sprayed between August 18th and 31st, and this increased the cost of the project too much for practical purposes. Pilot Mason spotted from the air some farm land near plots 11 and 12 which appeared to be suitable for landing strips. On the 31st we obtained permission to use a field gratis from which oats had just been harvested on the farm owned by Mrs. Grace K. Fuller, of Lincklaen (address DeRuyter, N.Y.). Fortunately this field was large enough

for a suitable plane runway and was situated on high ground within 1/2 mile of plot 12 and about 5 miles airline from plot 11. By using this field 13 plane loads of spray were distributed on the morning of September 2nd.

An examination of the reports on the white pine weevil control project for the past three years will show the advantage a helicopter would have over an airplane for making these spray applications, as there would be no long hauls and no loss of time because of a difference in weather conditions between the base of operations and the area to be sprayed.

Sampling and Methods Used

Damage in 1948

In August, trees were counted along lines through each plot making a record of those weeviled in 1948 and those not weeviled, in order to obtain data on the percentage of trees damaged this year by the weevil. The results of these counts are tabulated as follows:

Plot No.	No. Trees Counted	No. Trees Weeviled	Percentage of Trees Weeviled in 1948.
1	2400	1040	43.3
2	2050	877	42.8
3	2600	1215	46.7
4	2000	938	46.9
5	2000	607	30.4
6	2000	864	43.2
7	2000	1093	54.7
8	2000	737	36.9
9	2000	767	38.4
10	2000	615	30.8
11	1500	330	22.0
12	1000	446	44.6
	23,550	9,529	
	Average % not weeviled 59.5	% weeviled 40.5	

Thus, in the 12 plots, the damage in 1948 ranged from a low of 22 percent up to a high of 54.7 percent of the trees weevilled, with an average of 40.5 percent of all trees with the terminals killed this year.

Sampling Prior to Spray Applications

The same method as used in 1947 for obtaining data on the numbers of weevils present on the trees prior to spraying was used in part in 1948. An examination of some of the infested terminals about the middle of August, however, disclosed that only a few adults of the current year's brood had emerged. As an example two terminals examined on August 17th showed:-

No. 1 - 7 adults about to emerge, 39 pupae, and 4 larvae.

No. 2 - 0 adults about to emerge, 22 pupae, and 1 larva.

Because the emergence period in 1948 would be somewhat later than anticipated, it was decided to remove fifty infested terminals from each plot and take them into the laboratory for records of emergence. This part of the project was carried out by Messrs. Jaynes and Godwin. They found that emergence of weevils under laboratory conditions continued in 1948 from mid-August until the first of October. The peak of emergence, however, was about August 31st, and the period of highest emergence extended from the last week in August through most of the second week in September, varying somewhat from plot to plot. A summary of the emergence records is given as follows:

Plot No.	No. Infested Terminals	Date of Collection	Emergence No. Weevils	Emergence No. Parasites	Average Population per Terminal	Percent Parasitism
1	50	Aug. 17	1382	47	28.58	3.29
2	50	17	1250	53	26.06	4.07
3	50	18	983	43	20.52	4.19
4	50	18	1299	29	26.56	2.18
5	50	18	1162	42	24.08	3.49
6	50	18	1216	32	24.96	2.56
7	50	18	1048	29	21.54	2.69
8	50	18	1207	46	25.06	3.67
9	50	18	702	19	14.42	2.64
10	50	18	781	28	16.18	3.46
11	50	18	1601	3	32.08	0.19
Check 1	100	18	587	16	6.03	2.65
" 2	50	29	690	0	13.80	0.00
Totals	700	-	13908	387	20.42	2.71

Based on the emergence records from these collections the average population of weevils per infested terminal varied from 6.03 in check plot 1 to 32.08 in plot 11, with an average of 20.42 weevils per infested terminal in all plots. Although these records are for only one year, and the emergence was under laboratory conditions, they indicate some of the difficulties which must be overcome in order to obtain effective control by late summer applications of insecticides. They definitely show the need for an insecticide formulation which has a lasting residual effect, and also the importance of the proper timing of the application.

Post Treatment Sampling

The method of sampling in 1947 was used again this year. A "beater cloth" which consists of a piece of white sheeting, approximately one yard square, suspended between two light wooden poles for handles was held by one man beneath the branches of the upper whorls while the second man tapped or jarred the branches with a light club. The white pine weevils dropping onto the cloth were counted and recorded for each tree sampled. The following table gives data on dates of spraying, the insecticide and formulation used in each plot, and records of the numbers of trees sampled and the results. Only trees having the terminal weeviled in 1948 were sampled.

Results of Post Treatment Sampling

Plot No.	Date Sprayed August	Insecticide Formulation	Sampled Sept. 8-9 No.Trees	No.Weevils	(Average per Tree)	Sampled week of Sept.13th No.Trees	No.Weevils	(Average per Tree)
1	19	2 lbs. DDT in 2 gal.	(200	515	2.58	50	136	2.72
2	19 & 20	2 lbs. DDT in 2 gal.	(					
3	20	1 " DDT, 1 pt.BHC in 2 gal.	100	340	3.40	50	122	2.44
4	23 & 24	2 " DDT, 1 pt.BHC " 2 "	100	261	2.61	44	135	3.07
5	25	1 " DDT, 1 "Toxaphene in 2 gal.	60	127	2.12	25	48	1.92
6	26	2 " DDT, 1 "Toxaphene " 2 "	60	138	2.30	50	52	1.04
7	20 & 23	1 " DDT, 1 pt.BHC in 2 gal.	18	51	2.83	50	139	2.78
8	25	2 " DDT, 1 " BHC " 2 "	25	71	2.84	50	92	1.84
9	25 & 26	1 " DDT, 1 "Toxaphene in 2 gal.				30	48	1.60
10	27	2 " DDT, 1" Toxaphene " 2 "				50	149	2.94
11	Sept.2	2 " DDT, 1.6 pt.Toxaphene in 4 gal.	25	79	3.16	100	74	0.74
12	1 & 2	2 " DDT in 4 gal.				50	15	0.30
Checks	Near #11	None	15	108	7.20	50	414	8.28
"	Radio Tower	None				22	97	4.42
"	Mariposa	None				100	595	5.95

Analysis of Data from Plots treated by Airplane

The records show that most of the plots were sprayed prior to the maximum emergence of the 1948 brood of adults. Data from the collections taken into the laboratory for records on emergence show that in 1948, at least, the period of greatest emergence extended from the last week in August through most of the second week in September. Although the emergence tapered off tremendously about the middle of September, adults continued emerging until the first of October.

It is evident from the data given in the table on the previous page that some degree of control was obtained in all the plots treated, even in those sprayed prior to the maximum emergence. The most striking results, however, were obtained in plots 11 and 12, where the insecticides were applied at the rate of four gallons of emulsion per acre, and at about the peak of emergence. The results from three of the four plots treated with a combination of DDT and Toxaphene indicate this mixture is somewhat more effective than the other combinations of insecticides used this year. There is not enough significance in the results between most of the formulations to draw definite conclusions. The records of emergence this year indicate there is some chance that weevils taken in the final sampling may have just emerged, and that a few, at least, may not have come in contact with the insecticides prior to their capture. It is barely possible that the results may be somewhat better than is shown by the data on sampling. It will be necessary to examine the plots again in August 1949 before definite conclusions can be drawn on the results of these experiments.

The information obtained on the adult emergence this year, emphasizes the need of testing the effectiveness and practicability of aerial spraying early in the spring for the control of this weevil.

Results of 1947 Aerial Spraying for Control of the White Pine Weevil

A survey of the reforestation areas treated in September 1947 in Jefferson County, N.Y. was made by W. E. Smith and assistant late in July 1948 to obtain data on the results of the spraying. The 1947 and 1948 data have been tabulated in the following table.

Plot No.	Acreage	Date Sprayed 1947	Formulation & Dosage of DDT per acre	Weeviled leaders per 1000 trees Prior to Spraying 1947	1 yr. later 1948
3	125	Sept. 4 & 5	3 lbs. in 3 gal. soln.	218	34
4	88	4	4½ " " 4½ " "	241	18
6	88	16-17	4½ " " 4½ " "	286	45
7	70	17	3 " " 3 " "	256	136
8	90	17-23	4½ " " 4½ " emul.	273	16
9	90	7-13	3 " " 3 " "	308	21
10	90	6 & 7	4½ " " 4½ " "	251	12
12	102	14 & 16	1½ " " 1½ " "	335	185
13	105	5	1½ " " 1½ " soln.	289	243
15	85	13 & 14	1½ " " 3 " emul.	418	179
16	60	5	1½ " " 3 " soln.	235	155
5	Check - Not sprayed -			272	298
14	" " "			435	393

The results of this survey show rather conclusively that 1 1/2 pounds of DDT per acre, either as a solution or an emulsion, when applied from an airplane in September was not effective in controlling this weevil. Although perfect control was not obtained from any of the formulations used in 1947, the heavier dosages did produce some promising results.

Annual surveys of these plots will be made for several years to obtain data on the degree of infestation and damage, and to determine whether or not the majority of trees in the plots where the spray was most effective will reach one log length in height without again being weeviled.